THE IMPACT OF ORAL HEALTH LITERACY ON PERIODONTAL HEALTH STATUS

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ABSTRACT

CALEB LLOYD CORWIN**:** The Impact of Oral Health Literacy on Periodontal Health Status
(Under the direction of Dr. Jessica Y. Lee)

This cross-sectional study included new patients presenting to the University of North Carolina Graduate Periodontology Clinic. Socio-demographic and dental history information were collected. Oral health literacy (OHL) was measured using a dental word recognition instrument Rapid Estimate of Adult Literacy-30 (REALD-30). Clinical periodontal examinations were completed. 128 participants enrolled and 121 completed all study instruments. REALD-30 results indicated 33% had limited OHL (score $\leq$ 21). 31% had moderate OHL (score of 22-25), 37% had high OHL (score $\geq$ 26). Mean REALD-30 score was 23 (SD$\pm$ 4.3). 53% of participants had severe periodontitis, 29% had moderate periodontitis, and 18% had mild or no periodontitis. Bivariate associations were found between OHL and two PHS measures: overall periodontal status ($P<0.05$) and presence of probing depths (PD) greater than 6mm ($P<0.05$). The association between OHL and the two PHS measures remained significant in multivariate models controlling for smoking and race.

To my wife Erin,

Your unwavering love, encouragement, and support have strengthened me. I will forever be grateful.

And to my daughter Britton,

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LIST OF ABBREVIATIONS

CAL	Clinical Attachment Loss
CDC	Center for Disease Control
CEJ	Cemento-Enamel Junction
CI	Confidence Interval
GM	Gingival Margin
NAAL	National Assessment of Adult Literacy
NALS	National Adult Literacy Survey
OHL	Oral Health Literacy
OR	Odds Ratio
PD	Probing Depth
PHS	Periodontal Health Status
REALD-30	Rapid Estimate of Adult Literacy-30

1. INTRODUCTION AND LITERATURE REVIEW

1.1 Low Literacy is a Common Finding in the United States

Low literacy is common in the United States. The National Adult Literacy Survey (NALS) reported that 40 million adult Americans scored in the lowest of five levels (level 1) and another 50 million scored at level 2 [1]. These levels correspond to difficulty finding pieces of information or numbers in a lengthy text, integrating information in a document, or finding two or more numbers in a chart and performing a calculation [2]. This demonstrates that almost half of U.S. adults are unable to accurately and consistently use available print materials for everyday activities such as those related to health and safety, finance, or civic engagement [3]. Furthermore the number of functionally illiterate adults is currently on the rise, increasing by about 2.25 million each year [4].

The prevalence of low literacy tends to be much higher in groups of people who completed fewer years of education, persons of certain racial or ethnic groups, the elderly [1], and persons with lower cognitive ability [5].Other factors associated with lower literacy include being female, incarceration, and very low income. The results of the 1992 Adult Literacy Survey (National Center for Education Statistics, US Department of Education) indicate that adults with low literacy were more likely than those with higher literacy levels to be poor and to have health conditions which limit their activities [3].

1.2 Health Literacy Encompasses More than the Ability to Read

“Health literacy" refers to the ability to perform basic reading and numerical tasks necessary for navigating through the health care environment and acting on health care information [6]. Health literacy is defined in *Healthy People 2010* as: "The degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions" [7]. Health literacy includes the ability to understand information on prescription drug bottles, appointment slips, medical education brochures, doctor's directions and consent forms, and the ability to negotiate complex health care systems. It goes beyond one’s ability to read and includes, listening, analytical skills, decision-making skills, and their application to health situations.

The most recent National Assessment of Adult Literacy (NAAL) was the first survey implemented to assess the health literacy of adults in the U.S. population. It was found that literacy and health literacy are highly correlated. It was determined that 36% of the adult population have limited health literacy skills and have difficulty understanding basic health information [3].

Low health literacy can have a negative impact on one’s ability to function in the complex health care environment. It can affect patient-physician communication and in turn unintentionally leads to substandard medical care due to compliance issues or medication errors [6, 8]. Low health literacy is associated with poor understanding of written or spoken medical advice, adverse outcomes and has a negative effect on health at the population level [9, 10]. Approximately 77 million Americans cannot fully benefit from the offerings of a health-care system because of difficulty reading, processing, and acting upon health information provided to them [3]. Thus, individuals with low health literacy often have poorer health knowledge and poorer health status. In addition, there is a trend for these

individuals to have a decreased utilization of preventive services, increased rate of hospitalizations and chronic disease, and higher costs of health care [2, 6, 11, 12, 13]. Unfortunately, this means that the groups with the highest prevalence of chronic disease and require the most health care, have the most difficulty in reading and understanding information needed to address their medical needs [6].

1.3 Oral Health Literacy is a Priority for Future Research

Although the body of literature linking literacy to health continues to grow, only recently has oral health literacy been evaluated in dentistry**.** Modified from the previously mentioned definition of health literacy in Healthy People 2010, oral health literacy is defined as "the degree to which individuals have the capacity to obtain, process, and understand basic oral health information and services needed to make appropriate health decisions" [4].

Initial research evaluating the impact of OHL on an individual's oral health indicates similar findings to that of general health [14]. It is thought that limited OHL skills among adults are widespread and that it has a large effect on disparities, creating a barrier to achieving better oral health outcomes [4, 15].

1.4 Periodontitis is a Widespread Disease

National clinical oral epidemiological studies from developed countries have repeatedly estimated that over 90% of the general population has some form of periodontal disease and 4-10% have severe disease [16]. The American Academy of Periodontology (2005) estimates that approximately 50% of adults age 55-64 have at least one tooth with clinical attachment loss (CAL) $\geq$ 4 mm and 20% have CAL $\geq$ 6 mm [17].

1.5 Periodontitis can be Treated and Maintained with Patient Compliance

Classic studies have established that periodontal disease can be effectively treated and maintained over time. Hirschfeld and Wasserman observed the response of patients to periodontal therapy over a 15+ year period and noted that 83% of patients who were well maintained lost a maximum of 3 teeth [18]. Teeth with severe loss of periodontal support can be retained by means of a strict periodontal maintenance program. It was shown in a 14-year longitudinal study of treated and well maintained patients that only 2.3% of teeth with greater than 50% clinical attachment loss were lost [19]. Further studies demonstrated that periodontal maintenance treatment is effective in postponing tooth loss [20-22] and the importance of self care and plaque control with respect to maintainability of clinical attachment level gains following periodontal therapy [23-26].

While the lack of evidence in dentistry limits direct conclusions regarding the impact of literacy on oral health behaviors, knowledge, and outcomes, evidence from medical and public health research suggests that it might be significant, particularly when considered in tandem with other determinants of oral health [4].

2. SPECIFIC AIMS

The specific aims of this investigation were to 1) evaluate the level of oral health literacy among new patients seeking care at the University of North Carolina at Chapel Hill School (UNC-SOD) of Dentistry Graduate Periodontology Clinic and 2) to assess its association with periodontal health status in this population.

3. MATERIALS AND METHODS

3.1 Study Design and Eligibility for Participation

A cross-sectional study design was used to assess the relationship of the subjects' health literacy and their periodontal health status**.** The study was approved by the Biomedical Institutional Review Board at the University of North Carolina at Chapel Hill. Participants were recruited from new and referred patients presenting to the UNC-SOD Graduate Periodontology Clinics for either comprehensive or prescription periodontal care.

The inclusion criteria for participation in the study included: 1) 18 years of age or older, 2) English speaking (REALD-30 has been validated in adult English-speaking populations only) and 3) new or referred patients to the clinic (in an effort to obtain information on periodontal literacy prior to extensive exposure to and education on the topic).

3.2 Sample and Data Collection

A convenience sample of participants was recruited from among patients presenting for an initial consultation appointment to the UNC-SOD Graduate Periodontology Clinic. After obtaining written informed consent and a HIPAA consent form for study participation, one of two trained interviewers (who were blinded to the participant's periodontal status), administered the interview study instrument in a private setting. If the subject experienced

any difficulty reading the consent or HIPAA waiver forms, the interviewer read them aloud. Following the interview, a periodontal examination was completed by one of five calibrated examiner (who were blinded to the results of the health literacy study instruments). The participant's electronic patient record was reviewed by the initial examiner following the appointment to assess periodontal health status according to the Center for Disease Control (CDC) established criteria [16].

3.3 Variable Measurement

OHL was measured by one of two trained interviewers using the REALD-30 [2]. This previously validated (Cronbach's α=0.87) instrument includes 30 words arranged in order of increasing difficulty. Using REALD-30, the words were read aloud by the patient to the interviewer. Because REALD-30 is a word recognition test, participants were asked not to try to phonetically deduce the words, but rather to skip a word if they did not know it. To score the REALD-30, one point was given to each word pronounced correctly and summed to get an overall score. The total score had a possible range of 0 (lowest literacy) to 30 (highest literacy).

In addition to the REALD – 30, each patient completed questionnaires regarding their oral health knowledge (True/False questions), oral health behavior (categorical questions on oral hygiene and dental habits), and socio-demographic questions which were examined as exploratory covariates. Socio-demographic data collected included race, ethnicity, gender, marital status, education, age, annual family income, home ownership, amount of previous dental exposure, dental insurance status, and smoking status.

3.4 Clinical Assessment

Clinical periodontal parameters were measured using a UNC-15 periodontal probe at six sites per tooth (i.e., mesiobuccal, buccal, distobuccal, mesiolingual, lingual, and distolingual). The clinical parameters recorded included the following:

- Probing depth (PD) - distance from the gingival margin (GM) to base of the sulcus or pocket.
- Clinical attachment loss (CAL) - distance from the cemento-enamel junction (CEJ) to the base of the sulcus or pocket.

At proximal sites (mesiobuccal, distobuccal, mesiolingual, distolingual), the probe tip was placed as close to the interproximal area as possible. On the buccal and lingual surfaces of the tooth, measurements were made at the mid-buccal and mid-lingual points with the probe following the root contour. PD's were measured before CAL.

PD's were measured from the free GM to the base of the pocket and were recorded in millimeters. If a PD reading fell between two-millimeter readings, the examiner rounded down and the lower of the two readings was recorded.

CAL was measured directly from the CEJ to the base of the pocket and was recorded in millimeters. If a CAL reading fell between two-millimeter readings, the examiner rounded down.

Periodontal health status was determined based on extent and severity of periodontal lesions using the CDC case definition of periodontal disease [26] that defines disease as following:

- Severe Periodontitis: ≥2 interproximal sites with clinical attachment loss (CAL) ≥6 mm (on more than one tooth) and ≥1 interproximal site with probing depth (PD) ≥5 mm.
- Moderate Periodontitis: ≥2 interproximal sites with CAL ≥4 mm (on more than one tooth) or ≥2 interproximal sites with PD ≥5 mm (on more than one tooth).
- No or Mild Periodontitis: neither ‘‘moderate’’ nor ‘‘severe’’ periodontitis.

3.5 Examiner Training

Interviewers were trained and calibrated in the interview and survey methods. To ensure consistent and correct interview techniques, interviewers were also provided with an instructional manual (containing the data collection protocol, consent and HIPAA forms, and survey questions).

Prior to the conduct of this study, levels of intra- and inter-examiner reliability were determined for each examiner. A training exercise with a gold standard examiner was conducted to standardize measurement techniques and quantitate variability within and between examiners. This calibration served to establish intra- and inter-examiner agreement.

3.6 Data Analysis

Two options of scoring for literacy level as the explanatory variable were assessed: 1) sum of REALD-30 (continuous variable) or categorized REALD-30 (low literacy level (< 22), adequate literacy level (≥ 22)). There were two different types of outcomes: periodontal disease status (ordinal outcome (severe, moderate, mild/healthy) and probing depth category (nominal outcome (severe (PD > 6mm), healthy (no PD > 6mm)). Potential covariates were race (Caucasian, non-Caucasian); education (≤ high school, college ≥); dental insurance

(yes/no); smoking (current or former smoker, never smoked); family history of periodontal diseases (yes/no); age; and sum of oral health items. Because the two outcomes differ in scale of measurement and distributional properties, two different models were defined: the proportional odds model for periodontal disease status and the logistic regression model for probing depth category. For each model, potential covariates were then added to produce the final model. Forward variable selection was conducted for both models. The reference groups defined in the model were Caucasian, college ≥, having dental insurance, never smoked, and a positive family history of periodontal disease. All of the analyses were performed using SAS 9.1.

4. RESULTS

4.1 Descriptive Results

Among the 121 subjects recruited for the study (Table 1), slightly more than half of the participants were female and the majority were white (50.85% and 74.38%, respectively). Less than half (43.70%) of subjects had dental insurance. The majority of those with insurance (81.40%) were covered by private companies. A large portion of subjects (44.54%) had at least a 4-year college degree.

Most subjects presented to the UNC-SOD Graduate Periodontology Clinic for comprehensive periodontal treatment (72.65%), with the remainder referred for prescription procedures (ie: clinical crown lengthening, dental implant placement, gingival grafting) (Table 2). A portion of subjects smoked (13.22%). A large portion reported having quit smoking (44.63%). Less than half of subjects (42.15%) reported having never smoked. Very few patients reported having diabetes (4.96%).

Results from the behavior survey items (Table 2) revealed that the majority of subjects had recently been to the dentist (85.00%). With varied findings regarding frequency of brushing, flossing and use of mouthrinse.

Results from the REALD-30 indicated that one third of subjects (33.06%) had limited health literacy, as defined by a score of 21 or less. 30.58% of subjects fell into the moderate literacy level with a score of 22-25. There were 36.36% of subjects in the high

literacy level with a score of 26 or greater. The mean score was 23 with a standard deviation of 4.31.

From the clinical exam, over half of the subjects had severe periodontal disease (52.89%) with 28.93% having moderate periodontitis and the remaining subjects with mild or no periodontal disease (18.18%).

4.2 Analytic Results

Bivariate results indicated that race, smoking, and OHL were all significantly associated ($P<0.05$) with PHS (mild, moderate, severe) (Table 3) while education, family history, and insurance status were not. When examining presence of PD greater than 6mm, bivariate results indicated that race, smoking, and OHL (Table 4) were all significantly associated ($P<0.05$) while education, family history and insurance status were not. None of the measures were significantly associated with CAL in the bivariate analysis.

Table 5 reports the odds ratio, confidence intervals, and p-values for the (proportional odds) multivariate model for periodontal disease severity. REALD-30, race, dental insurance, and smoking were included in the final model for PHS. If REALD-30 decreases one unit then the likelihood of having severe periodontal disease was 1.19 times more likely adjusting for race, dental insurance and smoking ($P = 0.002$). Compared to Caucasians, Non Caucasians were 5.00 times more likely to have severe periodontal disease status adjusting for other variables ($P = 0.006$). Compared to people who have dental insurance, people without dental insurance were 2.32 times more likely to have severe periodontal disease status adjusting for other variables ($P = 0.043$).

Smokers were 3.86 times more likely to have severe periodontal disease status adjusting for other variables (P = 0.001) when compared to non-smokers.

Table 6 reports the odds ratio, confidence intervals, and p-values for the logistic multivariate model for presence of pocket depths greater than 6mm. REALD-30, race and dental insurance were included in the final model. If REALD-30 score decreased one unit then the subjects were 1.20 times more likely to have pocket depths greater than 6mm adjusting for race and dental insurance (P = 0.002). Compared to Caucasians, Non-Caucasians were 5.67 times more likely to have pocket depths greater than 6mm adjusting for other variables (P = 0.003). People without dental insurance were 3.11 times more likely to have pocket depths greater than 6mm adjusting for other variables (P = 0.016) when compared to people who have dental insurance.

5. DISCUSSION

To our knowledge this was the first study to examine the association between oral health literacy and periodontal health status. Although recent studies have highlighted the importance of oral health literacy as it relates to a patient's oral health, they have not focused specifically on periodontal health status. It has been demonstrated that there is an association between health literacy and chronic disease control. Diabetic patients with inadequate health literacy are more likely to have poor glycemic control with HbA1c $\geq$ 9.5 (OR 2.03, 95% CI 1.11-3.73, P = 0.01) and retinopathy (OR 2.33, 95% CI 1.19-4.57, P = 0.01) [29]. 92% of patients with an adequate level of health literacy know that a blood pressure of 160/100 mmHg is high, but only 55% of patients with an inadequate level of health literacy knew this [30]. Periodontal disease is chronic in nature; therefore patient understanding and compliance are essential for successful long-term maintenance and periodontal stability. The results of this study indicated that race, smoking, and oral health literacy were significantly associated ($P<0.05$) with periodontal health status (mild, moderate, severe). Education, family history, and insurance status were not significantly associated with periodontal health status.

Recent investigations report that low caregiver OHL is associated with lower oral health knowledge and poorer oral health status of the child. In a study of 106 caregiver-child dyads, children with mild to moderate treatment needs were more likely to have caregivers with higher REALD-30 scores (OR 1.14; 95% CI = 1.05, 1.25; P = 0.003) than

those with severe treatment needs [27]. Another recent investigation of 1158 caregiver-child dyads examined oral health literacy of caregivers (measured with the REALD-30). Results show that low literacy scores were associated with decreased knowledge (OR = 1.86; 95% CI = 1.41, 2.45) and poorer self reported oral health status (OR = 1.44; 95% CI = 1.02, 2.05) [28].

Oral health literacy has been examined among various adult populations as well. In a study of OHL among 200 participants from an urban dental clinic in Los Angeles, CA it was found that OHL was significantly associated with education level and an ability to speak English [31]. In an indigenous Australian population it was found that lower OHL was significantly associated with decreased dental knowledge and more harmful OHL related behavior [32].

Results from the current study demonstrate that as oral health literacy scores (sum of REALD 30) decreased by one unit the likelihood of having severe periodontal disease was 1.19 (P = 0.002), and the likelihood of having probing depths > 6mm was 1.20 (P = 0.002). If the REALD 30 score decreased by 2 points the patient was approximately 2.5 times more likely to have severe periodontal disease. Interestingly, the logistic regression demonstrated that the level of education was not significant (P = 0.394). This suggests that a patient's education level may not directly relate to their oral health literacy level. An educated patient may still be at increased risk for severe periodontal disease if their understanding of oral health and in particular, periodontal disease is lacking.

The findings of the present study reinforce the need for effective communication between dental health care providers and patients regarding their periodontal disease

condition. Due to the chronic nature of periodontal diseases and the importance of an effective maintenance program, it is imperative that the patient has an understanding of the risk factors and etiologic factors related to periodontal disease. They must be equipped to adequately control these factors to reach and maintain a level of periodontal stability and health.

These important findings must take into consideration study limitations. This study was cross sectional and therefore does not lead to casual inferences. The subjects included in the study were all new or referred patients presenting to the UNC-SOD Graduate Periodontology Clinic. It is likely that many of the participants have been previously seen in a private dental practice setting and may have received patient education. The high percentage of participants reporting brushing, flossing, and rinsing suggests previous education regarding plaque control. This may have lead to an increased OHL among the study population. The population sample in the present study is a convenience sample and is likely not an accurate representation of the general population as many were referred to the specialty clinic because of their disease. It is also important to understand the limitations of the REALD-30. It is a word recognition test and does not measure reading comprehension. Therefore it is not a comprehensive dental health literacy instrument. Finally, while examiners in this study were calibrated, slight variations in examination technique could have occurred among the multiple examiners in the study.

This study had several notable strengths. Clinical examiners were blinded to the results of the OHL instrument and did not know the OHL levels of the subjects at the

time of the periodontal examination. Additionally, interviewers assessing the literacy levels were blinded to the periodontal health status of the subject.

Although there were several examiners (2 interviewers, 5 clinical examiners) participating, each one was calibrated prior to participation in the study. The two interviewers were trained in interview and survey methods and were also provided with detailed instructions regarding data collection protocol, forms, and survey questionnaires**.** Periodontal determination of probing depths and clinical attachment loss are customarily used in clinical studies to measure the effects of periodontal therapy. The measurement of these periodontal parameters poses several limitations and technique-sensitive sources of variability. Probe penetration and depth may vary with the degree of inflammation, probing force, angulation, position and instrument tip diameter. Other confounding factors include patient discomfort, accuracy of probe markings, anatomical differences in tooth crown and roots, and technique variability within and between examiners. Studies evaluating periodontal disease and/or interventions require stringent control of measurement error. Therefore, each clinical examiner was calibrated to a gold standard examiner to standardize measurement techniques and quantitate variability. This calibration served to establish intra- and inter-examiner agreement.

Statistical analysis accounted for multiple factors and reported odds were adjusted for variables including race, level of education, dental insurance status, smoking, and family history of periodontal disease. One hundred and twenty one subjects were included in the study. This sample size was large enough for adequate power with respect to data analysis.

Many opportunities exist for further research examining the relationship between oral health literacy and periodontal disease status. Our study population was limited to patient's seeking treatment at the UNC-SOD Graduate Periodontology Clinic. It would be beneficial to extend the study population to include patients in various clinical settings including community health centers and private dental practices. This would not only increase the sample size but also allow for greater potential variation (ie: socio-economic status, education level, periodontal disease status) among subjects. Also, it would be valuable to perform a prospective study evaluating oral health and the effectiveness of various communicational and educational methods aimed at increasing a subject's oral health literacy.

Even with significant findings, the effect of low OHL on PHS is not clear. It has been shown that increased OHL is associated with better oral health and may be fundamental to oral health. Based on our findings, OHL may have an impact above and beyond education level.

Table 1. Sociodemographic Characteristics

Sex	Frequency (N)	Percent (%)
Male	58	49.15
Female	60	50.85
Race		
White	90	74.38
Black/African American	20	16.53
Hispanic/Latina	3	2.48
Native American	1	0.83
Asian	6	4.96
Dental Insurance		
Yes	52	43.70
No	67	56.30
Type of Dental Insurance		
Medicaid	4	9.30
Private	35	81.40
Other	4	9.30
Education Level		
Some High School or Less	3	2.52
High School Grad or GED	19	15.97
Some College or Technical Degree	44	36.97
4 Year College Degree or More	53	44.54
Marital Status		
Married	71	60.17
Separated/Divorced	25	21.19
Never Married or Single	13	11.02
Other	9	7.63
Annual Income		
Less than $10,000	14	12.28
$10,000 to $29,999	30	26.32
$30,000 to $49,999	31	27.19
$50,000 to $69,999	14	12.28
$70,000 to $89,999	13	11.40
$90,000 or More	12	10.53
Home Ownership		
Yes	83	76.15
No	26	23.85

Table 2. Dental and Health Characteristics

Reason for Clinic Visit	**Frequency (N)**	**Percent (%)**
Comprehensive Periodontal Treatment	85	72.65
Prescription Procedure	32	27.35
Previous Dental Care		
1-4 restorations/procedures	53	48.18
5 or more restorations/procedures	57	51.82
Time Since Last Dental Checkup/Cleaning		
More than 2 years	10	8.33
1 to 2 years	8	6.67
Less than 1 year	102	85.00
Frequency of Brushing Teeth		
Once/Twice a Week	4	3.31
Once a Day	26	21.49
More than Once a Day	91	75.21
Frequency of Flossing Teeth		
Never	1	0.83
Hardly Ever	12	9.92
Once/Twice a Week	32	26.45
Once a Day	52	42.98
More than Once a Day	24	19.83
Use Mouthrinse		
Yes	91	75.21
No	28	23.14
Don’t Know	2	1.65
Family History of Periodontal Disease		
Yes	24	20.34
No	94	79.66
Cigarette Smoking		
Current Smoker	16	13.22
Former Smoker	54	44.63
Never Smoked	51	42.15
Diabetes		
Yes	6	4.96
No	115	95.04

TABLE 3: Bivariate Relationships for OHL and PHS			
Clinical Periodontal Status	**Low OHL Score (21 or less)**	**Moderate OHL Score (22-25)**	**High OHL Score (26 or more)**
Severe	30 (24.79%)	17 (14.04%)	17 (14.05%)
Moderate	7 (5.79%)	13 (10.74%)	15 (12.40%)
Healthy/Mild	3 (2.48%)	7 (5.79%)	12 (9.92%)
Total	40 (33.06%)	37 (30.58%)	44 (36.36%)

* All variables significant at P < O.05 level

TABLE 4: Bivariate Relationships for OHL and Presence of PD > 6mm			
Probing Depth	**Low OHL Score (21 or Less)**	**Moderate OHL Score (22-25)**	**High OHL Score (26 or more)**
PD > 6mm	27 (22.31%)	16 (13.22%)	13 (10.74%)
No PD > 6mm	13 (10.74%)	21 (17.36%)	31 (25.62%)
Total	**40 (33.06%)**	**37 (30.58%)**	**44 (36.36%)**

* All variables significant at P < O.01 level

Table 5: Proportional odds model for OHL and periodontal disease status

Variable	DF	Estimate	95% C.I.	Wald χ^2	p-value
REALD-30 score (0-30)	1	1.19	(0.75, 0.94)	9.60	0.0019
Race (Non-Caucasian vs Caucasian)	1	5.00	(1.6, 15.61)	7.67	0.0056
Dental insurance (No vs Yes)	1	2.32	(1.03, 5.22)	4.11	0.0427
Smoking (Yes vs No)	1	3.86	(1.73, 8.61)	10.87	0.0010

Table 6: Logistical regression model for OHL and presence of PD > 6mm

Variable	DF	Estimate	95% C.I.	Wald χ^2	p-value
REALD-30 score (0-30)	1	1.20	(0.74, 0.94)	9.52	0.0020
Race (Non-Caucasian vs Caucasian)	1	5.67	(1.81, 17.73)	8.90	0.0029
Dental insurance (No vs Yes)	1	3.11	(1.24, 7.80)	5.82	0.0158

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